

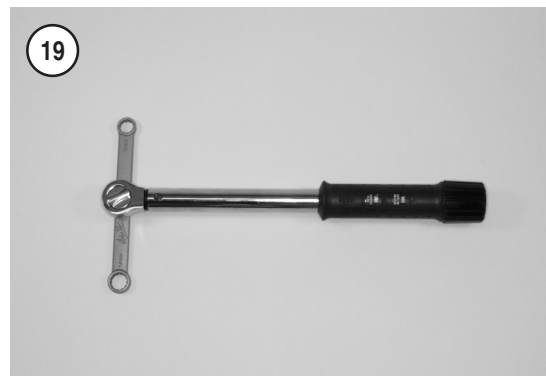
nese and European manufacturers. Allen head bolts are sometimes called socket bolts.

Torque Wrenches

A torque wrench is used with a socket, torque adapter or similar extension to tighten a fastener to a measured torque. Torque wrenches come in several drive sizes (1/4, 3/8, 1/2 and 3/4) and have various methods of reading the torque value. The drive size indicates the size of the square drive that accepts the socket, adapter or extension. Common methods of reading the torque value are the deflecting beam (A, **Figure 18**), the dial indicator (B) and the audible click (C).

When choosing a torque wrench, consider the torque range, drive size and accuracy. The torque specifications in this manual provide an indication of the range required.

A torque wrench is a precision tool that must be properly cared for to remain accurate. Store torque wrenches in cases or separate padded drawers within a toolbox. Follow the manufacturer's instructions for their care and calibration.



Torque Adapters

Torque adapters extend or reduce the reach of a torque wrench. The torque adapter shown in **Figure 19** is used to tighten a fastener that cannot be reached due to the size of the torque wrench head, drive, and socket. Since a torque adapter changes the effective lever length (**Figure 20**) of a torque wrench, the torque reading on the wrench does not equal the actual torque applied to the fastener. It is necessary to recalibrate the torque setting on the wrench to compensate for the change of lever length. When a torque adapter is used at a right angle to the drive head (**Figure 19**), calibration is not required, since the effective length has not changed.

To calculate the adjusted torque reading when using a torque adapter, use the following formula and refer to **Figure 20**. The formula can be expressed as:

$$TW = \frac{TA \times L}{L + A}$$

TW is the torque setting or dial reading on the wrench. TA is the torque specification and the actual amount of torque that will be applied to the fastener. A is the amount that the adapter increases (or in

some cases reduces) the effective lever length as measured along the centerline of the torque wrench from the center of the drive to the center of the adapter box end (**Figure 20**). L is the lever length of the wrench as measured from the center of the drive to the center of the grip. The effective length of the torque wrench is the sum of L and A .

For example, to apply 20 ft.-lb. to a fastener, using an adapter as shown in the top example in **Figure 20**:

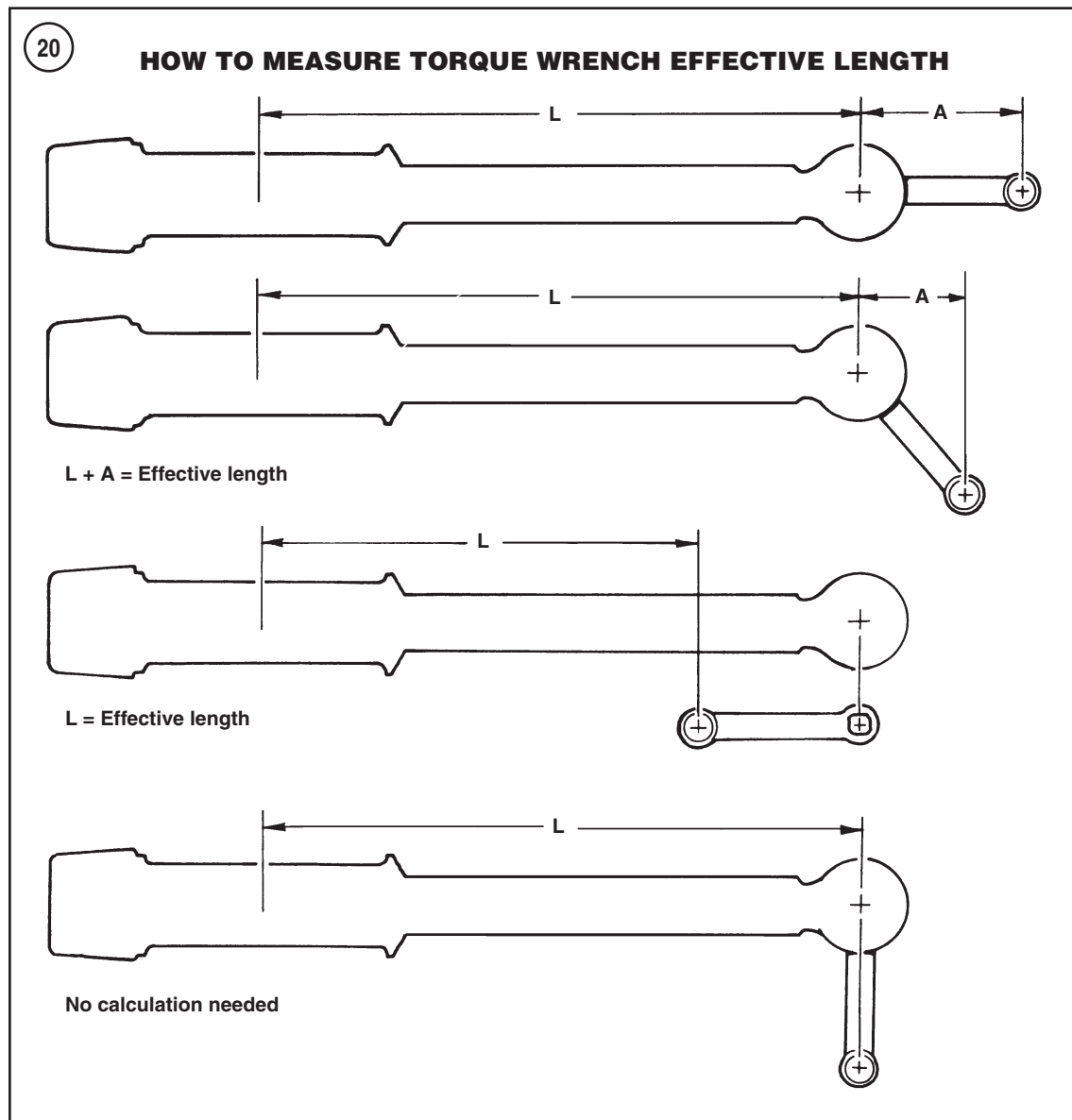
$$TA = 20 \text{ ft.-lb.}$$

$$A = 3 \text{ in.}$$

$$L = 14 \text{ in.}$$

$$TW = \frac{20 \times 14}{14 + 3} = \frac{280}{17} = 16.5 \text{ ft. lb.}$$

In this example, a click-type torque wrench would be set to the recalculated torque value ($TW = 16.5$ ft.-lb.). When using a dial or beam-type torque wrench, tighten the fastener until the pointer aligns with 16.5 ft.-lb. In either case, although the torque wrench reads 16.5 ft.-lb., the actual torque is 20 ft.-lb.



Pliers

Pliers come in a wide range of types and sizes. Pliers are useful for holding, cutting, bending and crimping. Do not use them to turn fasteners. **Figure 21** shows several types of useful pliers. Each design has a specialized function. Slip-joint pliers are general-purpose pliers used for gripping and bending. Diagonal cutting pliers cut wire and can be used to remove cotter pins. Adjustable pliers can be adjusted to hold different size objects. The jaws remain parallel so they grip around objects such as pipe or tubing.

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